



B A S M A A

Alameda Countywide
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Management Program

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Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

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Water Agency

Vallejo Sanitation
and Flood
Control District

Bay Area

Stormwater Management

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April 29, 2011

Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Green Roof Minimum Specifications - MRP Provision C.3.c.iii.(4)

Dear Mr. Wolfe:

This letter and attachment are submitted on behalf of all 76 permittees subject to the requirements of the Municipal Regional Stormwater NPDES Permit (MRP).

MRP Provision C.3.c.i.(2)(vii.) states:

Green roofs may be considered biotreatment systems that treat roof runoff only if they meet certain minimum specifications. By May 1, 2011, the Permittees shall submit for Water Board approval proposed minimum specifications for green roofs. This submittal to the Water Board shall, at a minimum, contain the information required in Provision C.3.c.iii.(4). Once the Water Board approves green roof minimum specifications, the Permittees shall ensure that green roofs installed to meet the requirements of Provision C.3.c. and C.3.d. comply with the Water Board-approved minimum specifications.

MRP Provision C.3.c.iii.(4) requires the Permittees, collaboratively or individually, to submit a report to the Water Board containing the following information:

- Proposed minimum design specifications for green roofs;
- Relevant literature and field data showing the feasibility of the minimum design specifications;
- Relevant literature, field, and analytical data showing adequate pollutant removal and compliance with the Provision C.3.d. hydraulic sizing criteria;
- Discussion of data and lessons learned from already installed green roofs;
- Discussion of barriers, including institutional and technical site specific constraints, to installation of green roofs and proposed strategies for removing these identified barriers; and
- Guidance for the Permittees to apply the minimum specifications in a consistent and appropriate manner.

Through the Bay Area Stormwater Management Agencies Association (BASMAA), the Permittees have worked together to develop the attached report, which addresses each of these requirements. The Permittees reviewed available literature, including USEPA's 2009 report, "Green Roofs for Stormwater Runoff Control," considered their experience with green roof projects in their jurisdictions, and queried some Bay Area developers who have experience with green roof projects or have evaluated using green roofs in their projects.

Our report concludes that typical green roof designs meet the C.3.d. hydraulic sizing criteria for treatment systems.

A recent media release by Green Roofs for Healthy Cities states the green roof industry grew by more than 16% in 2009. This acceleration in green roof installations appears to be separate from the influence of standards, requirements, or other regulatory drivers related to stormwater pollution prevention. The primary drivers include energy efficiency, reduction of greenhouse gases, credits toward LEED certification, and environmental cachet. Barriers to green roof construction appear to be cost and the regional development community's lack of familiarity with green roof construction; these barriers are already being overcome through the active promotion of green roof technology by groups such as Green Roofs for Healthy Cities.

As required, our report proposes strategies for furthering green roofs and overcoming barriers to green roofs and includes language the Permittees intend to incorporate in their C.3 compliance guidance for applicants for development approvals.

Please contact Jill Bicknell, BASMAA Development Committee Chair, at 408-720-8811 if you have any questions about the submittal or need additional information.

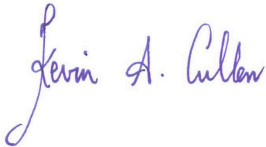
We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



James Scanlin, Alameda Countywide Clean Water Program



Tom Dalziel, Contra Costa Clean Water Program



Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program



Matt Fabry, San Mateo Countywide Water Pollution Prevention Program



Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program



Lance Barnett, Vallejo Sanitation and Flood Control District

Attachment: Green Roof Minimum Specifications

cc: Tom Mumley, Regional Water Board
Shin-Roei Lee, Regional Water Board
Dale Bowyer, Regional Water Board
Sue Ma, Regional Water Board
BASMAA Board of Directors

**Bay Area
Stormwater Management
Agencies Association**

Green Roof Minimum Specifications

Provision C.3.c.iii.(4)

**Submitted to the
California Regional Water Quality Control Board
San Francisco Bay Region
29 April 2011**

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APPENDIX A: BAY AREA GREEN ROOF PROJECT EXAMPLES

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Disclaimer: This document is not intended to provide general specifications or guidance for design or construction of green roofs. Discussion of and recommendations for minimum requirements are limited to elements of green roof design related to compliance with stormwater treatment requirements.

1 • Introduction

Green roofs are vegetated roof systems that filter, absorb, and retain or detain the rain that falls upon them. Green roof systems are comprised of a layer of planting media planted with vegetation, underlain by other structural components including waterproof membranes, synthetic insulation and geofabrics.

A green roof can be either *extensive*, covering most of the roof's surface with typically up to 7 inches of lightweight planting media and a few types of low-profile, low-maintenance plants, or *intensive*, with a thicker planting media (8 to 48 inches), more varied plantings including shrubs and trees, and a more garden-like appearance.

Rain that falls onto green roofs is returned to the atmosphere either by evaporation or transpiration by plants, which remove the water from the planting media. When the media becomes saturated, the excess water percolates through to the drainage layer and is discharged through the roof downspouts. Green roofs can provide high rates of rainfall retention and decrease the peak flow rate because of the temporary storage that occurs in the media during discharge events.

The San Francisco Bay Area Municipal Regional Stormwater Permit (MRP) Provision C.3.c.i.(2)(b)(vii) states:

Green roofs may be considered biotreatment systems that treat roof runoff only if they meet certain minimum specifications. By May 1, 2011, the Permittees shall submit for Water Board approval, proposed minimum specifications for green roofs. This submittal to the Water Board shall, at a minimum, contain the information required in Provision C.3.c.iii.(4). Once the Water Board approves green roof minimum specifications, the Permittees shall ensure that green roofs installed to meet the requirements of Provision C.3.c. and d. comply with the Water Board-approved minimum specifications.

MRP Provision C.3.c.iii.(4) requires the permittees to submit to the Water Board, by May 1, 2011, a report including:

- Proposed minimum design specifications for green roofs;
- Relevant literature and field data showing the feasibility of the minimum design specifications
- Relevant literature and field data showing adequate pollutant removal and compliance with the Provision C.3.d. hydraulic sizing criteria;

- Discussion of data and lessons learned from already installed green roofs;
- Discussion of barriers, including institutional and technical site-specific constraints, to installation of green roofs and proposed strategies for removing these barriers;
- Guidance for the Permittees to apply the minimum specifications in a consistent and appropriate manner.

This report addresses each of these requirements, in order.

2 • Minimum Design Specifications for Green Roofs

A green roof system consists of a number of components, which may include vegetation, planting media, geotextile fabric, a supporting structure and drainage system, insulation, root barrier, and waterproof membrane. It is not the intention of this document to provide specifications for all elements of a green roof but rather to specify the minimum requirements to comply with the stormwater low impact development (LID) treatment requirements. These minimum requirements are limited to the elements necessary for stormwater treatment, i.e. the depth of planting media, selection of appropriate plants, and the ability of the media and other components to support healthy plants.

Having conducted a literature review and considered the relevant questions, the permittees recommend the following regarding the use of green roofs for stormwater runoff control.

Minimum specifications for green roofs should be consistent with Provision C.3.c.i.(2)(b), which states: “Require each Regulated Project to treat 100% of the amount of runoff identified in Provision C.3.d. for the Regulated Project’s drainage area with LID treatment measures...” Provision C.3.d. states that Permittees shall require that stormwater treatment systems constructed for Regulated Projects meet either the Volume Hydraulic Design Basis criteria or the Flow Hydraulic Design Basis criteria.

Provision C.3.d.i.(1) provides a Volume Hydraulic Design Basis which may be calculated by either of two methods. These methods yield, for the Bay Area, required unit basin storage volumes ranging from approximately 0.6 to 1.3 inches over the drainage area to the treatment measure, depending on location and rainfall patterns. This equates to about 0.1 cubic feet or less for each square foot of roof area (assuming 100%

imperviousness). Granular soils or engineered media typically used in green roof construction have a porosity of 0.4 or more. Therefore, a green roof with a planting medium that is 0.1 feet/0.4, or 0.25 feet (3 inches) deep provides the required volume specified by Provision C.3.d.i.(1) within the pores of the media. The minimum media depth to achieve the required C.3.d volume could be less in some areas, again depending on rainfall patterns and the porosity of the planting media used.

Provision C.3.d.i.(2) provides a Flow Hydraulic Design Basis which may be calculated by any of three roughly equivalent methods. One of these methods is “the flow of runoff resulting from a rain event equal to at least 0.2 inches per hour intensity.” Granular soils typically used in green roof construction have an infiltration rate of considerably more than 0.2 inches per hour. Therefore a green roof (regardless of media depth) meets the requirements of Provision C.3.d.i.(2) at least as effectively as a conventional roof routed through an LID facility (such as biotreatment) built to the hydraulic sizing design criteria specified in Provision C.3.d.i.(2).

The permittees conclude the minimum specifications in Provision C.3.d., as referenced in Provision C.3.c.(2)(b), should apply to green roofs and can be met by typical green roof designs.

The key factor for designing a green roof that provides effective stormwater retention and treatment is the ability of the planting media to support healthy plants. Development project applicants should work with a landscape architect or similar professional to select appropriate plants for the roof location and determine the appropriate media depth to support those plants. To maximize the effectiveness of green roofs with regard to on-site retention and treatment, permittees will also encourage designs that use soil media deeper than the minimum required to support plants. Designs with deeper soil media are increasingly used to support a wider variety of plantings, including native plant palettes that can mimic pre-development ecology.

In summary, the following minimum design specifications for green roofs are recommended:

- The planting media used in a green roof system shall be sufficiently deep to provide capacity within the pore space of the media for the required runoff volume specified by Provision C.3.d.i.(1).
- The planting media used in a green roof system shall also be sufficiently deep to support the long term

health of the vegetation selected for the green roof, as specified by a landscape architect or other knowledgeable professional.

3 • Relevant Literature and Field Data

3.1 Feasibility of the Minimum Design Specifications

The technical feasibility of constructing green roofs to meet the C.3.d. requirements is established by existing green roofs in the region, including the GAP Headquarters Building in San Bruno, the retail building occupied by West Elm in Emeryville, and the Academy of Sciences building in San Francisco, as well as much more extensive implementation of green roofs in other US cities (notably Chicago) and in Europe.

Appendix A summarizes information about example Bay Area green roof projects.

3.2 Adequate Pollutant Removal and Compliance with Sizing Criteria

Compliance with the Provision C.3.d. hydraulic sizing criteria is discussed above.

There is no standard or definition, in the MRP or elsewhere, for “adequate pollutant removal.” Like preceding municipal stormwater NPDES permits, the MRP does not specify requirements for treatment effectiveness or for effluent quality. The International Stormwater BMP Database (2008) illustrates that stormwater BMPs exhibit wide ranges of effluent quality and pollutant removal.

In a review of water quality data for green roofs, Johnson (2008) states: “While... data suggest that green roofs can be designed to filter some pollutants from rainwater, none are comprehensive enough to validate long-term performance of green roof designs.” USEPA (2009) notes studies of green roof performance in North America are of pilot-scale or sometimes commercial-scale green roofs without replication. The Pennsylvania studies reported in USEPA (2009) found green roof runoff appears similar to what might be expected as leaching from any other planted system in the landscape. Total phosphorous was comparable to that in residential stormwater runoff. Nitrate concentrations, on the other hand, were similar for green roof and asphalt roof runoff.

As stated in USEPA (2009): “The greatest benefit green roofs can provide is the reduction in runoff...” USEPA (2009) concludes green roofs can retain over 50% of total precipitation. The data

cited is from Pennsylvania, and it was found retention was nearly 95% during summer months and much smaller (less than 20%) during winter months. Vegetation plays an important role in making soil moisture available for evapotranspiration.

In a final report on the Seattle Green Roof Evaluation Project, Magnusson Klemencic Associates (2007) report volume reductions of 65% to 94% over an 18-month period. The authors note green roofs are “amazingly capable of rebounding between events.”

All studies reviewed indicate reduced peak flows and increased times of concentration for all storms. The most common practice for extensive green roofs incorporates 3 to 4 inches of growing medium vegetated with a mixture of sedum plants. These systems have shown to achieve 50% to 75% water retention in a typical year, while significantly increasing the time of concentration for larger storms.

We found no available data on green roof performance for the Bay Area or similar semi-arid climates. Interpretive information for the California Academy of Sciences states 98% of runoff is retained.

We conclude pollutant removal by green roofs is as good as that of accepted treatment BMPs and considerably better than many BMPs when reductions in runoff volume are taken into account.

4 • Discussion of Data and Lessons Learned

Innovation in green roof design continues. Some recent examples of innovation include the use of waste polystyrene as one component of the soil media mix; use of increased depths (to 6 inches) to increase rainfall retention and reduce irrigation requirements, and an emphasis on native plants and creation of native-like habitats (Compton, 2006). Magnusson Klemencic Associates (2007) suggest there is an optimal depth for green roof soil media for stormwater control, and that the depth is dependent on climate. In Seattle, a 6-inch depth of the media used allowed the entire depth to become unsaturated at least some of the time, while maximizing the unsaturated depth available to absorb rainfall from subsequent storms.

USEPA (2009) suggests, based on monitoring of five precipitation events at a limited number of test sites, that green roof runoff appears similar, in the concentration of nutrients and ions, to leaching from other planted systems in the landscape. However,

nitrate concentrations were similar to runoff from conventional roofs. The authors suggest avoiding direct discharge of green roof drainage to receiving waters.

5 • Discussion of Barriers and Proposed Strategies

Use of green roofs is still in its infancy in the US, in comparison to Germany where many cities offer substantial financial incentives and an estimated 12% of flat roofs are green roofs (Live Science, 2009). However, green roofs are growing in the US, as evidenced by the amount of activity and example projects at www.greenroofs.org. A recent media release by Green Roofs for Healthy Cities states the green roof industry grew 16.1% in 2009, reaching an estimated 10 million square feet annually.

The acceleration of green roof installations is occurring separate from the influence of standards, requirements, or other regulatory drivers related to stormwater pollution prevention. Rather, primary drivers include energy efficiency, reduction of greenhouse gases, credits toward Leadership in Energy and Environmental Design (LEED) certification (Federal Energy Management Program, 2004), and environmental cachet (Velasquez and Kiers, 2007).

The primary barriers to green roof construction appear to be cost and the regional development community's lack of familiarity with green roof construction. Costs in the US have been high in comparison to costs in Europe, perhaps due to lack of familiarity with the technology, use of imported materials, and lack of industry standards (Federal Energy Management Agency, 2004). These factors seem more significant than remaining institutional and technical constraints, as evidenced by the rapid expansion in the use of green roofs throughout various states and regions.

In preparation for this report, 12 Bay Area developers participated in a survey regarding perceived obstacles to implementing green roofs. Three had actual experience with green roof projects, and an additional three had evaluated the option of a green roof for one or more specific projects but decided to use a conventional roof instead. Significant perceived barriers include:

- Cost of initial construction
- Cost of maintenance
- Additional structural requirements for buildings
- Lack of incentives offered by local governments

- Uncertainty in the local development review process
- Liability concerns

Among perceived effective incentives, tax incentives, green building credits (such as LEED) and grant funding were noted.

Complete survey results are shown in Appendix B.

Barriers to green roof installation are already being overcome through the active promotion of green roof technology by groups such as Green Roofs for Healthy Cities.

Increasingly widespread interest in LEED accreditation is also furthering green roofs. The following LEED credits may potentially be earned by incorporating a green roof in a development project, subject to meeting the specific LEED criteria for each credit:

- SS 5.1 Protect or Restore Habitat
- SS 5.2 Maximize Open Space
- SS 6.1 Stormwater Quantity Control
- SS 6.2 Stormwater Quality Control
- SS 7.2 Heat Island Effect, Roof
- WE 1.1 Water Efficient Landscaping, Reduce irrigation by 50%
- WE 1.2 Water Efficient Landscaping, No potable water use or no irrigation

Green roofs could potentially contribute to additional LEED credits in specific cases. It should be noted that requirements for LEED credits for stormwater quantity and quality control are somewhat different than requirements for MRP compliance.

The more rapid and widespread adoption of green roofs in Chicago, Washington, DC, and in German cities seems due to specific financial and zoning incentives created by municipal government. Incentives offered by US cities and states include direct incentives (property tax abatements, grants, and loans) and indirect incentives (reduced permit fees, credits against stormwater utility fees, “fast track” permitting, density and zoning bonuses, and recognition and awards programs) (DC Greenworks, 2010). Another incentive is the avoidance of the cost to upgrade storm drain capacity to accommodate increased runoff from the development project, since the green roof will mitigate the increase in runoff.

BASMAA proposes the following strategies for furthering green roofs and overcoming barriers to green roofs:

- When reviewing applications for development approvals, permittees will credit green roofs as LID treatment in accordance with Provision C.3.i.(2)(b). This may include categorizing green roofs as “self retaining ares: or as “self-treating areas.”
- Permittees will seek to integrate their review of proposals to use green roofs for NPDES compliance for new developments with consideration of such proposals in connection with municipal climate change, urban greening, green infrastructure, sustainable development, energy efficiency, and other related environmental programs the municipalities are implementing.
- BASMAA will prepare and publish guidance detailing the similarities and differences between MRP requirements for green roofs and LEED points obtainable from green roofs and suggesting ways planners and designers can design roofs to achieve both benefits.
- BASMAA and the permittees will communicate with green roof industry proponents to ensure they have accurate information about the benefits of green roofs with regard to water quality and also with regard to MRP compliance.
- BASMAA and the permittees will continue to evaluate trends in green roof design, and encourage the use of design features that maximize runoff retention, evapotranspiration and treatment, as appropriate.
- Permittees will refer applicants for development approvals to information and design resources created by the green roof industry.
- The permittees will consider conducting an investigation of retention and evapotranspiration on one or more green roofs as a potential “BMP Effectiveness Investigation” per MRP Provision C.8.d.ii. In particular, it may be useful to set up long-term monitoring of rainfall, pan evaporation, soil moisture, and drainage flows at a green roof to evaluate characteristics specific to the Bay Area’s semi-arid climate and to facilitate calibration of rainfall/runoff models applicable to green roofs.

6 • Guidance for Permittees

The permittees will include the following in their C.3 compliance guidance to applicants for development approvals.

- Inclusion of green roofs in LID designs is encouraged.
- Green roofs may be credited as “self-retaining areas” or as “self-treating areas” for treatment and hydrograph modification management.
- The planting media used in a green roof system must be sufficiently deep to provide capacity within the pore space of the media for the required runoff volume specified by Provision C.3.d.i.(1). If the green roof system receives runoff from non-green areas of the roof, such as mechanical/HVAC equipment areas or impervious walkways, the depth of the media must be increased to account for the additional runoff.
- The planting media used in a green roof system must be sufficiently deep to support the long term health of the vegetation selected for the green roof, as specified by a landscape architect or other knowledgeable professional.
- Plants should be selected which will create a healthy, drought-tolerant roof cover. In general, selected plants should be:
 - Native or adapted species tolerant of extreme climate conditions (e.g., heat, drought, wind);
 - Low-growing, with a range of growth forms (e.g., spreading evergreen shrubs or subshrubs, succulents, perennials, self-seeding annuals);
 - Possessive of a shallow root system without the chance of developing a deep taproot; and
 - Long lived or self-propagating, with low maintenance and fertilizer needs.
- Vegetation must be maintained in a healthy state for the life of the project.
- Irrigation systems may be required to establish and/or maintain selected plants. In addition, local fire codes may require irrigation systems to prevent a fire hazard or for emergency fire suppression.
- Applicants should be encouraged to drain green roofs to landscape or to bioretention facilities where

feasible to do so. Drainage directly to receiving waters should be avoided.

- Buildings with green roofs should provide the required facilities (e.g., ladders, guard rails, tie offs) to ensure safe access by maintenance workers in compliance with OSHA regulations.

7 • References

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Geosyntec Consultants (2011). Minimum Criteria for Green Roofs as "Self-Retaining." Memorandum to BASMAA Development Committee, 15 February 2011.

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Velasques, Linda S., and Haven Kiers. "Hot Trends in Greenroof Design 2007: Chic Sustainability, Unique Driving Factors and "Boutique" Greenroofs." At www.greenroofs.org.

USEPA (2009). "Green Roofs for Stormwater Runoff Control".
Authors: Berghage, Robert D., David Beattie, Albert R. Jarrett,
Christine Thuring, and Farzaneh Razaei. US Environmental
Protection Agency, EPA/600/-09/026.

Appendix A: Bay Area Green Roof Project Examples

West Elm Furniture Store, Emeryville. A 5,879-square-foot monolithic green roof was constructed on a commercial building, comprising about 1/3 of the total roof area. The roof met the current City requirement to treat stormwater with a vegetated BMP and also contributes to store branding and association with sustainability goals. Skylights were incorporated into the design to allow for roof access and meet Fire Marshal requirements. *Contact:* Peter Schultze-Allen, City of Emeryville, 510-596-3728, pschultze-allen@ci.emeryville.ca.us.

Casa Feliz Studio Apartments, San Jose. A 5,375-square-foot green roof was constructed on a 60-unit affordable multi-family residential building. The building is part of redevelopment of a 0.34-acre site; the roof helped the project qualify for LEED gold certification and avoid a costly capacity upgrade to a local storm drain. The roof is designed to retain up to 80% of stormwater. *Contact:* Juan Borrelli, City of San Jose, 408-793-4384, juan.borrelli@sanjoseca.gov.

4th Street Apartments, San Jose. A 15,200-square-foot green roof was provided for a multi-family apartment building with 100 apartments and two floors of covered parking. A drip irrigation system was installed to facilitate plant establishment. *Contact:* Juan Borrelli, City of San Jose, 408-793-4384, juan.borrelli@sanjoseca.gov.

AgeSong Assisted Living Facility, Emeryville. A 4,640-square-foot modular green roof includes 4-inch-deep cells with pre-grown drought-tolerant plants and covers about a third of a parking structure rooftop. The roof met a current City requirement to treat stormwater with a vegetated BMP and provides an opportunity for residents and the public to visit the roof. *Contact:* Green Grids, 818-350-7330.

San Jose Police Southside Substation, San Jose. A 3-story, 107,000-square-foot building on a 10.5-acre site includes a green roof, which helped the project obtain LEED certification. *Contact:* Juan Borrelli, City of San Jose, 408-793-4384, juan.borrelli@sanjoseca.gov.

Appendix B: Results of Developer Survey

You have a **BASIC account** | To remove the limits of a BASIC account and get unlimited questions, [upgrade now!](#)**Building Industry Green Roof Survey** [Edit](#)

Default Report

[+ Add Report](#)**Response Summary**Total Started Survey: 12
Total Completed Survey: 12 (100%)

PAGE: IDENTIFYING OBSTACLES TO BUILDING GREEN ROOFS IN THE SAN FRANCISCO BAY AREA

1. Please indicate the number of projects that you have worked on that either (a) INCLUDED a green roof, or (b) did not include but EVALUATED use of a green roof.[Download](#)

Number of applicable projects:

	0 projects	1 project	2 projects	3 projects	4 projects	5 or more projects	Response Count
a. Projects that INCLUDED a green roof:	75.0% (9)	0.0% (0)	0.0% (0)	0.0% (0)	8.3% (1)	16.7% (2)	12
b. Projects that EVALUATED but did not include a green roof:	50.0% (6)	16.7% (2)	0.0% (0)	8.3% (1)	0.0% (0)	25.0% (3)	12
answered question							12
skipped question							0

2. From the following list, please rate the "Top-Ten" issues that you perceive as barriers to developing green roofs.[Create Chart](#)[Download](#)

	Most significant barrier									Least significant barrier	N/A	Rating Average	Response Count
Lack of green roof professionals	0.0% (0)	0.0% (0)	0.0% (0)	18.2% (2)	0.0% (0)	0.0% (0)	9.1% (1)	18.2% (2)	18.2% (2)	36.4% (4)	0.0% (0)	8.09	1
Lack of standard green roof specifications	0.0% (0)	9.1% (1)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	9.1% (1)	27.3% (3)	18.2% (2)	18.2% (2)	0.0% (0)	7.09	1
Lack of incentives offered by local governments	36.4% (4)	9.1% (1)	0.0% (0)	18.2% (2)	0.0% (0)	0.0% (0)	0.0% (0)	18.2% (2)	9.1% (1)	0.0% (0)	9.1% (1)	3.90	1
Uncertainty in the local development review process	9.1% (1)	0.0% (0)	36.4% (4)	0.0% (0)	9.1% (1)	27.3% (3)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	0.0% (0)	4.64	1
Barriers to financing and insurance	0.0% (0)	9.1% (1)	9.1% (1)	18.2% (2)	36.4% (4)	0.0% (0)	18.2% (2)	0.0% (0)	9.1% (1)	0.0% (0)	0.0% (0)	5.09	1
Cost of construction	33.3% (4)	16.7% (2)	25.0% (3)	0.0% (0)	8.3% (1)	8.3% (1)	8.3% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	2.92	1
answered question												12	
skipped question												0	

2. From the following list, please rate the "Top-Ten" issues that you perceive as barriers to developing green roofs.

[Create Chart](#)[Download](#)

Cost of ongoing maintenance	0.0% (0)	36.4% (4)	0.0% (0)	18.2% (2)	18.2% (2)	18.2% (2)	9.1% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	4.09	1
Liability concerns	27.3% (3)	0.0% (0)	9.1% (1)	9.1% (1)	18.2% (2)	18.2% (2)	0.0% (0)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	4.45	1
Lack of knowledge within my firm	0.0% (0)	8.3% (1)	0.0% (0)	0.0% (0)	8.3% (1)	0.0% (0)	25.0% (3)	8.3% (1)	25.0% (3)	8.3% (1)	16.7% (2)	7.30	1
Aesthetic appearance of green roofs	0.0% (0)	0.0% (0)	9.1% (1)	0.0% (0)	0.0% (0)	18.2% (2)	9.1% (1)	9.1% (1)	9.1% (1)	45.5% (5)	0.0% (0)	8.09	1
Other (please specify) Show Responses													:
answered question													1
skipped question													1

3. What are some specific financing barriers to green roof construction (check all that apply)?

[Create Chart](#)[Download](#)

	Response Percent	Response Count
Existing policies of financial institutions/lenders	16.7%	2
Existing policies of insurance companies	33.3%	4
Lack of knowledge on the part of financial institutions	25.0%	3
Lack of knowledge on the part of insurance companies	33.3%	4
Don't know	58.3%	7
Other (please specify)	0.0%	0
answered question		12
skipped question		0

4. What are some specific green roof construction cost concerns that may be barriers to green roof development (check all that apply)?

[Create Chart](#)[Download](#)

	Response Percent	Response Count
Specialized consultants	58.3%	7
Additional infrastructure costs are considered a barrier for any size project	41.7%	5
Additional infrastructure costs MAY be a barrier depending on the overall size or cost of a project	33.3%	4
answered question		12
skipped question		0

4. What are some specific green roof construction cost concerns that may be barriers to green roof development (check all that apply)?

[Create Chart](#)
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Lack of standard specifications	33.3%	4
Maintenance costs	75.0%	9
Don't know	8.3%	1
Other (please specify) Hide Responses	16.7%	2

1. liability

Wed, Nov 3, 2010 4:00 PM

[Find...](#)

2. Additional structural impacts

Mon, Oct 25, 2010 3:05 PM

[Find...](#)

answered question

12

skipped question

0

5. Please identify specific technical or institutional challenges/barriers with constructing green roofs (check all that apply).

[Create Chart](#)
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	Response Percent	Response Count
Building code requirements	41.7%	5
Fire code and life safety requirements	25.0%	3
Conflicts with green building codes, green-house gas reduction requirements and/or water and energy conservation and efficiency requirements	33.3%	4
Lack of or insufficient warranties for materials such as waterproofing membrane	75.0%	9
Structural requirements for buildings	58.3%	7
Other (please specify)	0.0%	0

answered question

12

skipped question

0

6. Please indicate which of the following would be likely to motivate you to build a green roof project (check all that apply).

[Create Chart](#)
[Download](#)

	Response Percent	Response Count
Seeing local examples of how green roofs provided benefits to development projects, such as reduced energy costs, extended roof life, habitat value, improved aesthetics and/or market value, etc.	25.0%	3

answered question

12

skipped question

0

6. Please indicate which of the following would be likely to motivate you to build a green roof project (check all that apply).

[Create Chart](#)[Download](#)

Grant funding

41.7%

5

Tax incentives

66.7%

8

Requirement to provide non-mechanical
stormwater treatment

25.0%

3

Clear information regarding requirements is
provided by local jurisdictions

33.3%

4

Earning green building credits under a green
building rating system (such as LEED or
GreenPoint Rated)

50.0%

6

Other (please specify)

[Hide Responses](#)

8.3%

1

1. none

Wed, Nov 3, 2010 4:00 PM

[Find...](#)

answered question

12

skipped question

0

7. Please identify green roof liability issues/concerns with regard to, primarily,
for-sale projects (check all that apply).

[Create Chart](#)[Download](#)

Response
Percent

Response
Count

Potential for leaks

83.3%

10

Maintenance requirements

91.7%

11

Other (please specify)

[Hide Responses](#)

25.0%

3

1. ambulance chasing lawyers

Wed, Nov 3, 2010 4:00 PM

[Find...](#)

2. There are potentially NO increases liabilities; membrane lasts longer and is better
protected, studies have shown actual fire protection. If accessible, may trigger
insurance liabilities associated with access and not necessarily the green roof.
Maintenance CAN be increased, but not necessarily so.

Wed, Nov 3, 2010 12:16 PM

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3. Some warranties can be voided by change in ownership.

Wed, Nov 3, 2010 10:40 AM

[Find...](#)

answered question

12

skipped question

0

8. Please describe any other specific factors not already included above that would make a green
roof NOT economically or technically viable.

answered question
skipped question

1
11

8. Please describe any other specific factors not already included above that would make a green roof NOT economically or technically viable.

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	Response Count
Hide Responses	1

1. Primarily cost barrier and in some cases structural loading (certain types of existing buildings).

Wed, Nov 3, 2010 12:16 PM

[Find...](#)

answered question	1
skipped question	11

9. Which of the following describes your profession (check all that apply)?

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	Response Percent	Response Count
Developer of commercially funded projects	41.7%	5
Affordable housing or other non-profit developer	8.3%	1
Engineering consultant	8.3%	1
Architect	16.7%	2
Other (please specify) Hide Responses	33.3%	4

1. Landscape Architect

Wed, Nov 3, 2010 12:41 PM

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2. Landscape Architect

Wed, Nov 3, 2010 12:16 PM

[Find...](#)

3. Landscape Architect

Wed, Nov 3, 2010 10:40 AM

[Find...](#)

4. Retail

Mon, Nov 1, 2010 9:10 AM

[Find...](#)

answered question	12
skipped question	0

10. If you would like to receive email updates regarding stormwater requirements for development projects, please provide your contact information below.

[Download](#)

	Response Percent	Response Count
Name: Show Responses	100.0%	9
Company: Hide Responses	100.0%	9
answered question	9	
skipped question	3	

10. If you would like to receive email updates regarding stormwater requirements for development projects, please provide your contact information below.

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1.	Americap Development Partners	Wed, Nov 3, 2010 2:30 PM	Find...
2.	Design Ecology / UCB	Wed, Nov 3, 2010 12:16 PM	Find...
3.	WRA, Inc	Wed, Nov 3, 2010 10:40 AM	Find...
4.	Lewis Planned Communities	Wed, Nov 3, 2010 9:35 AM	Find...
5.	DRG Builders	Wed, Nov 3, 2010 7:48 AM	Find...
6.	dk Consulting	Fri, Oct 29, 2010 3:58 PM	Find...
7.	Agemark	Tue, Oct 26, 2010 1:30 PM	Find...
8.	Peter G. Shutts	Mon, Oct 25, 2010 3:05 PM	Find...
9.	Eden Housing	Mon, Oct 25, 2010 2:21 PM	Find...
Street Address: Show Responses		88.9%	8
City, State, Zip: Show Responses		88.9%	8
Phone Number: Show Responses		100.0%	9
Email Address: Show Responses		100.0%	9
		answered question	9
		skipped question	3